3a

The Nature of Technology

- ✓ Technology and Science
- ✓ Design and Systems
- ✓ Issues in Technology

THE NATURE OF TECHNOLOGY - Technology and Science
Grade K-2 (Benchmark 1 of 2)

By the end of 2nd grade all students will know that --

Tools are used to do things better or more easily and to do some things that could not otherwise be done at all. In technology, tools are used to observe, measure, and make things.

Suggested Activity:

Invite the custodian to demonstrate simple hand tools. Show students a nail that has been hammered into a board. Ask how the nail can be removed given different tools. Show students some table salt with a magnifying glass and ask how they can see the shape of each small piece. Ask students to measure other students who are not standing near each other to see who is the tallest. Have students make an alphabet book with pictures of tools.

Embedded Assessment:	Match tools with appropriate tasks.
Summative Assessment:	The same types of activities, using different examples.
Theme:	Constancy and Change
Process:	Language Proficiency, esp. identifying appropriate materials

By the end of 2nd grade all students will know that --

When trying to build something or to get something to work better, it usually helps to follow directions if there are any or to ask someone who has done it before for suggestions.

Suggested Activity:

Give students paper and tape and ask them to build a block or a square. They may consult whenever and whomever they wish, either inside the classroom or outside of it. Try origami. Have students teach one another how to build different types of paper airplanes. Extend the activity to baking, building a model, etc. Use Legos, blocks, or paper airplanes for a hands-on example.

Embedded Assessment:	Why did one group finish first? How could we have made their job even faster and easier?
Summative Assessment:	List ways you can get help when a group wants to build something that is hard to build.
Theme:	Systems
Process:	Proficiency in Making Products, esp. building/testing/refining prototypes

By the end of 5th grade all students will know that --

Throughout all of history, people everywhere have invented and used tools. Most tools of today are different from those of the past but many are modifications of very ancient tools.

Suggested Activity:

Have individual students select a modern tool and create a model of both it and an ancient precursor or what that particular technology might look like in the future. Good examples would be hammers, screwdrivers, levels, flat irons, egg beaters and bottle openers. Then have them explain to their peers the relationship between the two tools.

Embedded Assessment:	List similarities and differences in chart form.
Summative Assessment:	Have groups of students develop exhibits of the technological evolution of particular classes of tools, e.g. agricultural or manufacturing.
Theme:	Constancy and Change
Process:	Psychomotor Proficiency, esp. manipulating materials, creating diagrams and drawings

Arrange a visit to your local high school, New England Tech or Johnson & Wales University to observe the difference between traditional board design and CAD design. Contact Erin Kavanaugh at NEIT (467-7744) or Dean David Mello at Johnson & Wales (598-4601).

By the end of 5th grade all students will know that --

The products of technology enable scientists and others to observe things that are too small or too far away to be seen without them and to study the motion of objects that are moving very rapidly or are hardly moving at all.

Suggested Activity:

Students observe objects with magnifying glasses, binoculars, telescopes, and microscopes, depending on what is available. Students view time lapse photography and slow motion video. Use VCR tape of students in slow motion of frame by frame to analyze sports performance.

Embedded Assessment:	Compare what you see with and without the technology.
Summative Assessment:	Students select a particular need to see better or more fully in the present, envision a technological solution to this dilemma, and explain the positive benefits of such a technology. Write a story about the use of this technology.
Theme:	Scale
Process:	Experimental Proficiency, esp. observing

Contact the RI Medical Society (Jackie Bigelow at 331-3207) to see if you can arrange a visit by a sports medicine specialist. The Amateur Astronomical Society of RI (726-1328) is another excellent source for speakers, trips and materials that would link to this benchmark.

By the end of 5th grade all students will know that --

Measuring instruments can be used to gather accurate information for making scientific comparisons of objects and events and for designing and constructing things that will work properly.

Suggested Activity:

Build a toy with moving parts. After practice in using measuring tools to compare objects and/or events, present students with an object, like a pyramid made from coffee stirrers. Have students build a smaller or larger identical object to scale.

Embedded Assessment:	Is the object built correctly?
Summative Assessment:	Students describe what would have gone wrong if they had not measured and/or multiplied or divided accurately.
Theme:	Scale
Process:	Mathematical Proficiency, esp. measuring

Have an *Invention Convention*! Using graph paper and sugar cubes pair students to design and build a three-dimensional figure. Name and describe. Other students or a panel of retired citizens evaluate for accuracy. Invite professionals to visit and share their experiences with models (e.g., doctors, architects, CAD designers, engineers, city planners). Contact associations of retired professionals (check the What's Out There? directory published by RIMSEC, RIOHE and RIDE for suggestions).

By the end of 5th grade all students will know that --

Technology extends the ability of people to change the world: to cut, shape, or put together materials; to move things from one place to another; and to reach farther with their hands, voices, senses, and minds. The changes may be for survival needs such as food, shelter, and defense, for communication and transportation, or to gain knowledge and express ideas, or entertainment.

Suggested Activity:

Students make a chart on which they list technologies they use for obtaining food, shelter, defense, communication, and transportation. Have students bring in and report on a new technology that affects their life but did not exist during their parents' childhood.

Embedded Assessment:	Successful production of one sample portion of the chart, presentation to peers, selection of device.
Summative Assessment:	Compare technologies used by students in the class with those which might be used in different periods of time or from different cultures. Compare how new technology changed their lives, i.e., compact discs vs. 45 records.
Theme:	Constancy and Change
Process:	Language Proficiency, esp. comparing

From Ms. Frey's Class
Henry Barnard School
Providence, Rhode Island
Fifth Grade Activity

Building a Freshwater Pond

The fifth-graders in Ms. Frey's class built a freshwater pond with a waterfall in their classroom, and built a year-long curriculum around the study of this pond. Planning, design and measurement played a key role in the construction of this pond. Experts were consulted for their advice on design. The students measured and calculated the pond size and the quantity of water needed to fill the pond. Water displacement had to be predicted. And, of course, the pond had to be built and maintained! A truly interdisciplinary curriculum sprang up around the freshwater focus. Ms. Frey refers to this process as 'weaving a tapestry of learning.'

Science

- *Studied ecosystems, pond characteristics and littoral habitats.*
- *Classified and identified fresh water inhabitants through the construction of retrieval charts.*
- *Built and designed scale models of water driven devices such as clocks & water wheels.*

History

- *Traced the history fresh water played in the development of Rhode Island.*
- *Recreated locks, canals and towpaths in the sand table to gain an understanding of mills.*
- *Researched the role of fresh water in today's communities.*
- *Mapped the location of fresh water sources in Rhode Island.*

Language Arts

- *Dialogued with professionals, grandparents, retired citizens, and parents regarding fresh water ecosystems, local fresh water sources and environmental problems.*
- *Wrote poems and books for kindergarten children with fresh water themes.*
- *Read and discussed books with fresh water settings.*
- *Created fiction and non-fiction publications.*
- *Planned presentations including videos, photographs, and sketches.*
- *Designed and stitched a pond quilt with an accompanying book of sketches, stories, and autobiographies.*

Mathematics

- *Measured and calculated pond size and the quantity of water needed to fill the pond.*
- *Predicted water displacement, graphed water evaporation and temperature correlation of the pond, estimated plant and animal growth and compared the results.*
- *Routinely used problem solving strategies to maintain the pond.*
- *Created and programmed Lego/Logo fresh water creatures.*

A bibliography and list of resources are available from Ms. Frey at Henry Barnard. She also welcomes visitors to her pond, but asks that you call first to schedule a convenient time.

THE NATURE OF TECHNOLOGY - Technology and Science
Grade 6-8 (Benchmark 1 of 3)

By the end of 8th grade all students will know that --

In earlier times, the accumulated information and techniques of each generation of workers were taught on the job directly to the next generation of workers. Today, the knowledge base for technology can be found as well in libraries of print and electronic resources and is often taught in the classroom.

Suggested Activity:

Invite a local worker (e.g., carpenters, auto mechanics, electricians, plumbers) who is currently employed and a retired professional to compare and contrast their training and information access yesterday and today. Follow-up might include a class collage to display this workplace transformation to the school. Access data on CD ROM and on-line telecommunications to serve a particular purpose. For example, track Monarch Butterflies using internet resources, visit a vocational HS to view various technologies.

Embedded Assessment: Generate a report on the topic(s) from the class activity.

Summative Assessment: Have students take something they know how to do, e.g., a personal hobby or a particular skill, and encapsulate that knowledge/expertise in some form where it can be accessed by others.

Theme: Constancy and Change

Process: Manipulating Information

THE NATURE OF TECHNOLOGY - Technology and Science
Grade 6-8 (Benchmark 2 of 3)

By the end of 8th grade all students will know that --

Science and technology are essential to one another for such purposes as access to outer space and other remote locations, sample collection and treatment, measurement, data collection and storage, computation, and communication of information.

Suggested Activity:

Visit a local technology or science-intensive company or the URI Bay Campus. Document all the ways in which people within the company utilize science and technology in their everyday jobs.

Embedded Assessment: In conjunction with a visit to the URI Bay Campus, discuss how undersea exploration has changed since the invention of sonar, underwater photography, and deep sea exploration vessels, e.g., Alvin. What are the advantages and disadvantages of these changes?

Summative Assessment: The student will explain how space exploration has evolved, integrating many different technologies and career fields in their explanation.

Theme: Systems

Process: Manipulating Information

THE NATURE OF TECHNOLOGY - Technology and Science
Grade 9-12 (Benchmark 1 of 3)

By the end of 12th grade all students will know that --

Technological problems often create a demand for new scientific knowledge, and new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research. The very availability of new technology itself often sparks scientific advances.

Suggested Activity:

Have students compare the abacus, adding machine, slide ruler, calculator, and computer and how this evolution changed scientific research and technological progress. How will the use of internet change scientific research and technological progress?

Embedded Assessment: Given an actual or paper model slide rule and a hand-held calculator, the student will explain why slide rules are no longer commonly used by scientists.

Summative Assessment: Discuss the changes in music recording in the 20th century.

Theme: Constancy and Change

Process: Developing Explanatory Frameworks

Visit the Computer Museum in Boston (tel. 617-426-2800, ext. 334 to make reservations, or 1-800-370-2447 for general information) to learn about the history of computers and walk through the inside of a computer!

THE NATURE OF TECHNOLOGY - Technology and Science
Grade 9-12 (Benchmark 2 of 3)

By the end of 12th grade all students will know that --

Mathematics, creativity, logic, and originality are all needed to improve technology.

Suggested Activity:

Design and build a model bridge using pasta, tape and string (see the vignette on the next page). Or, given a protractor, string, and tape measure, determine the height of a tall street light.

Embedded Assessment: Submit a drawing and written report explaining why your design is an improvement.

Summative Assessment: Create a design and construction activity for other students to use that does not involve a bridge.

Theme: Constancy and Change

Process: Proficiency in Making Products

From Mr. Rapose's Class
Pilgrim High School
Warwick, Rhode Island
High School Activity

The Pasta Bridge

In this activity students use information and equations they have been studying in a physical science or physics class to construct a bridge using spaghetti. The materials required for the activity are a half-pound of #3 spaghetti per student, string, glue, masking tape, an eye bolt and block, and a 20 kilogram mass set.

The students are given the task of constructing a spaghetti bridge that will hold 40 times its own mass. The maximum mass allowed for the bridge is 500 grams or half a pound.

The Rules:

1. The bridge can weigh no more than 500 grams.
2. Students may work alone or in pairs.
3. The bridge must have a span (length) of 25 cm.
4. The bridge width must be at least 5 cm.
5. The bridge must have a roadbed of 20 cm. width and a 4x4 cm. opening in the middle.
6. The bridge will have no height limits, but a 2x2x5 weighing block must be able to fit in the center span.
7. Glue, masking tape or string may be used in any combination to hold the bridge together, but the completed bridge cannot exceed the set weight limit.

First, a blueprint of the bridge that they are going to build must be produced. Next they must construct a working prototype that can hold at least ten times it's mass. Changes and readjustments can be made here as needed before the final bridge is produced. Finally the bridges are massed and the block and eye bolt are placed in the center of the road bed where masses are added until the bridge supports 40 times its mass (or collapses). Grades are determined on aesthetics and the mass the bridge is able to support.

This bridge project is a great deal of fun for students. It builds excitement and helps to spark interest in a subject that many students fear. The project also requires students to apply knowledge they have learned about force and gravity. Of course, a pasta lunch is recommended to culminate the activity.

THE NATURE OF TECHNOLOGY - Technology and Science
Grade 9-12 (Benchmark 3 of 3)

By the end of 12th grade all students will know that --

Technology usually affects society in different ways than basic science because it solves practical problems and tries to serve human needs (and may create new problems and needs). In contrast, basic science affects society mainly by stimulating and satisfying people's curiosity and occasionally by enlarging or challenging their views of what the world is like.

Suggested Activity:

A gel electrophoresis test may be performed on a given DNA sample to ascertain its identity. Students describe the sequence of steps involved in the process, brainstorm range of applications for this technology, and identify applications presently in use.

Embedded Assessment:	Identify which two DNA samples (actual or photographs) are the same.
Summative Assessment:	Discuss the role of science and technology in a criminal investigation.
Theme:	Constancy and Change
Process:	Proficiency in Making Products

Dr. Robert Krasner at Providence College has run biotechnology workshops for science teachers during the summer months for the past several years. Teachers who complete these workshops may borrow the equipment to conduct gel electrophoresis testing in their classroom. Contact Dr. Krasner directly at 865-2239 for further information on the workshops. Unfortunately, due to the very high demand he cannot loan equipment to teachers who have not completed the course.

THE NATURE OF TECHNOLOGY - Design and Systems
Grade K-2 (Benchmark 1 of 2)

By the end of 2nd grade all students will know that --

People can use objects and ways of doing things to solve problems.

Suggested Activity:

Divide students into groups and give each group an 8" square pan of water and same materials (e.g., sponge, Legos, tinkertoys, rubber bands, paper). Make a Lego person. How many different ways can your Lego person cross the water? Be prepared to demonstrate using the materials you have. This would be a fun activity for including senior citizens as participants, recorders and spectators.

Embedded Assessment:	Selected students discuss how use of a particular object helped in the achievement of their objective.
Summative Assessment:	Students present one problem of personal importance and describe a combination of various tools (objects as well as ideas) that they can use to solve the problem.
Theme:	Systems
Process:	Generating Novel Ideas

THE NATURE OF TECHNOLOGY - Design and Systems
Grade 3-5 (Benchmark 1 of 3)

By the end of 5th grade all students will know that --

There is no perfect design. Designs that are best in one respect (safety or ease of use, for example) may be inferior in other ways (cost or appearance). Usually some features must be sacrificed to get others. How such trade-offs are perceived depends upon which features are emphasized and which are down-played.

Suggested Activity:

Bring in a deck of cards and have the students build card houses, using many different designs. For each design have them create a diagram of its key features and analyze its strengths and weaknesses.

Embedded Assessment:	Discuss what is most important to look for when buying a particular toy or a particular game. What might you do if it is good in some ways and bad in others?
Summative Assessment:	Design a rating system to be used for evaluating childrens' toys and games.
Theme:	Systems
Process:	

By the end of 5th grade all students will know that --

Even a good design may fail. Sometimes steps can be taken ahead of time to reduce the likelihood of failure, but it cannot be entirely eliminated.

Suggested Activities:

Have students bring in a broken toy and explain how it broke. Brainstorm ways the design might be improved and inherent limitations in design improvement. Build and test working models which exhibit some of these improvements and assess their viability and worth. Have students design and build a humane mouse trap using Legos.

Embedded Assessment:	Have each student prepare and present a design solution to at least one problem with the broken toy.
Summative Assessment:	Repeat embedded assessment with something other than a toy, such as a broken appliance.
Theme:	Systems
Process:	Ensuring Desired Quality

By the end of 5th grade all students will know that --

The solution to one problem may create other problems.

Suggested Activity:

Ask students to suggest solutions to a local problem such as heavy traffic on a road or too many passengers on the school bus. Environmental problems or issues would be good sources. Assign each group one of the solutions to further explore. What is good and bad about this particular solution? What new problems will likely arise?

Embedded Assessment:	Have each student identify and defend one proposed solution.
Summative Assessment:	Repeat the activity with a different problem and look for evidence of learning transfer.
Theme:	Systems
Process:	Identifying intended and unintended consequences of an action.

By the end of 8th grade all students will know that --

Design usually requires taking constraints into account. Some constraints, such as gravity or the properties of the materials to be used, are unavoidable. Other constraints, including economic, political, social, ethical, and aesthetic ones, limit design choices.

Suggested Activity:

Students will design and build a bridge using 50 straws and 2 meters of tape. Have the bridge span two chairs and see whose bridge can span the greatest distance without touching the floor. Invite a city or town official to visit the class and describe a recent construction project.

Embedded Assessment:	Students will construct and 'test' (destroy) their bridge.
Summative Assessment:	Students will critique their design and suggest ways to improve it. They will also discuss limitations to their improvements.
Theme:	Models
Process:	Proficiency in Making Products

By the end of 8th grade all students will know that --

Systems fail because they have faulty or poorly matched parts, are used in ways that exceed what was intended by the design, or were poorly designed to begin with. The most common ways to prevent failure are pretesting parts and procedures, overdesign, and redundancy.

Suggested Activities:

Have students redesign the bridge they built from straws (previous activity) to improve performance. Allow sufficient time and provide enough materials for students to adopt a 'systems approach' to bridge improvement. Have students design a container with strings, sticks, Styrofoam and an egg carton that can keep an egg intact when it is dropped from a high elevation.

Embedded Assessment:	Discuss why some systems approaches worked well and others did not.
Summative Assessment:	Select a relatively small system, such as a classroom or a home, and catalogue faulty or poorly matched components and examples of built-in redundancy.
Theme:	Systems
Process:	Proficiency in Reaching Decisions

By the end of 12th grade all students will know that --

In designing a device or process, thought should be given to how it will be manufactured, operated, maintained, replaced, and disposed of and who will sell, operate, and take care of it. The costs associated with these functions may introduce yet more constraints on the design.

Suggested Activity:

Have students contact their local Chamber of Commerce to locate a local company or independent producer. Invite a representative to address the class about the development and marketing of their product. Then examine the yearbook production process, identify relevant constraints, and see if the process could be made more efficient and/or effective.

Embedded Assessment:	Present empirical evidence for one aspect of the yearbook process that is a candidate for improvement and identify two or more possibilities for change.
Summative Assessment:	Analyze the school bus scheduling or course scheduling process, identifying constraints and possible improvements.
Theme:	Systems
Process:	Proficiency in Making Products

By the end of 12th grade all students will know that --

The value of any given technology may be different for different groups of people and at different points in time.

Suggested Activity:

Undertake a cross-curricular study between science and social studies classes on the role of technology during the Industrial Revolution in New England and the demise of these factory sites. (Lowell, MA and its Tsongas Industrial History Museum is an ideal site for such an exploration or one of the many 'living' historical villages in New England.)

Embedded Assessment:	Students will list the immediate and broad impacts of the invention of the steam engine.
Summative Assessment:	Create a videotape describing key insights the class has gleaned from their investigation using real-life examples.
Theme:	Continuity and Change
Process:	Proficiency in Informed Action

Visit Slater Mill in Pawtucket (tel. 725-8638) and continue up the Blackstone River. Dr. Patrick Malone (Urban Studies) and Dr. Susan Smulyan (American Civilization) at Brown University have written about the river and its impact on society.

By the end of 12th grade all students will know that --

Complex systems have layers of controls. Some controls operate particular parts of the system and some control other controls. Even 'fully' automatic systems require human control at some point.

Suggested Activity:

Students will examine the central heating system or trash collection system of their school (with the approval and involvement of appropriate staff/administration).

Embedded Assessment:	Students will construct a flow chart of the heating system or trash collection system of their school.
Summative Assessment:	Students will design other possible alternative heating or trash collection systems for their school, based upon information obtained from a variety of human and non-human resources.
Theme:	Systems
Process:	Problem Solving Proficiency

Contact the RI Solid Waste Management Corp. (277-2797) or the OSCAR program (277-3434) for extended activities and curriculum resources dealing with solid waste management.

THE NATURE OF TECHNOLOGY - Design and Systems
Grade 9-12 (Benchmark 4 of 6)

By the end of 12th grade all students will know that --

Risk analysis is used to minimize the likelihood of unwanted side effects of a new technology. The public perception of risk may depend, however, on psychological factors as well as scientific ones.

Suggested Activity:

Identify a local controversial issue such as high voltage electricity transmission (EMF), solid waste disposal or land development. Conduct a risk/benefit analysis for this issue. Use Sim City computer simulation for this activity.

Embedded Assessment:	Submitted risk/benefit analysis.
Summative Assessment:	**Give students a scenario of a large company moving into their community. The company produces a product of the teacher's choosing. Students will develop a risk/benefit analysis from the perspective of the company as well as from the perspective of their community.**
Theme:	Systems
Process:	Proficiency in Informed Action

By the end of 12th grade all students will know that --

The more parts and connections a system has, the more ways it can go wrong. Complex systems usually have components to detect, back up, bypass, or compensate for minor failures.

Suggested Activity:

A discussion of movies such as Apollo 13 and Jurassic Park, or real events such as the Challenger disaster, nuclear power plants (Chernobyl, Three Mile Island) could introduce the importance of back-ups, failure, and human error. Students will design and construct a working model of a machine designed to perform a simple task (i.e., picking up a pencil) through a complex system of mechanisms. Students will evaluate the energy efficiency and reliability of this device.

Embedded Assessment:	Plan and analysis of effectiveness and reliability of machines constructed.
Summative Assessment:	Modification of constructed machine to perform a given additional task (i.e., moving pencil to new location).
Theme:	Systems
Process:	Proficiency in Making Products

By the end of 12th grade all students will know that --

To reduce the chance of system failure, performance testing is often conducted using small-scale models, computer simulations, analogous systems, or just the parts of the system thought to be least reliable.

Suggested Activity:

Have students use one or more computer simulations and compare their worth in simulating real-world situations.

Embedded Assessment:	A sufficiently detailed analysis of a real-world analysis as the basis for evaluating the reasonableness of the selected computer simulation.
Summative Assessment:	Study a simulation that has been widely used as a basis for a real-world discussion and document its effects over time (examples include Star Wars, Nuclear Winter, war games, global change models, sea flood spreading and plate tectonics, modeling of epidemics).
Theme:	Models

From Ms. Ose's class
Andrews School
Bristol/Warren Regional Schools
Fourth Grade Activity

The Great Solar System Rescue:
A Cooperative Learning Videodisk Activity

What started as a special enrichment lesson for one class turned into a month long learning adventure for all 4th grade students at the Andrews School in Bristol. By watching a videodisk on the solar system, students found clues about various planets in order to locate a lost probe, while spending the least amount of money. Ultimately, approximately 200 children from every learning population experienced a simulated space exploration using this program.

Students were broken into teams of four (a geologist, an astronomer, a meteorologist and a historian). While watching the videodisk for 'lost probe transmission information', students took notes relating to their specialty. Ms. Ose would voice over the key facts at each step of the transmission and emphasize which specialists might want to make note of them.

Students compared notes and generated questions for a culminating scientific space forum, where they presented their findings in their specialty area.

During the month this program was presented, many 4th graders stopped Ms. Ose in the hall to see when the next 'installment' was coming. Several students brought special posters or other information to class to stimulate the discussion. The diversity of kids who participated contributed to making the experience more enriching for all. Limited English speaking students were encouraged by their English speaking peers to illustrate the shapes of the planet.

Learning gains were measured by teacher observation, and with the use of debriefing questions. Students gained insight into what various scientists do and what they look for when they are analyzing data. They experienced what it means to be part of a team, to count on someone else's information and to experience the consequences of making correct and incorrect choices. This cooperative learning activity allowed students to understand the solar system through a multimedia learning program where each child has a special role to play and can contribute to the solution of a common problem.

Information on *The Great Solar System Rescue* Videodisc is available from Tom Snyder Productions (tel. 1-800-342-0236).

THE NATURE OF TECHNOLOGY - Issues in Technology
Grade K-2 (Benchmark 1 of 2)

By the end of 2nd grade all students will know that --

People, alone or in groups, are always inventing new ways to solve problems and get work done. The tools and ways of doing things that people have invented affect all aspects of life.

Suggested Activity:

Discuss how TV has affected the lives of people, especially children. Compare what life was like when student's parents were their age and what life is like today. List machines that have become common place in the 30 year span.

Embedded Assessment:	See how many aspects of life students recognize as being affected by TV. Construct a comparative chart of life thirty years ago and the present.
Summative Assessment:	Pick a tool in your house. Describe how it affects your life in the form of a visual wheel of effects. Pick a device that existed in their parent's generation and today. List how it has changed and how the change has affected life.
Theme:	Systems
Process:	Identifying Relationships

By the end of 2nd grade all students will know that --

When a group of people wants to build something or try something new, they should try to figure out ahead of time how it might affect other people.

Suggested Activity:

Groups of students should be assigned the task of creating new recreation models for the school, including sandbox, swingset, pool, basketball court. Each group should construct a diorama of their proposed design. With the design there should be a list of how this new structure will affect other people. Who else should be consulted before the construction on the playground addition is started? Brainstorm. Project presentations should be delivered to a panel of 'experts' - principal, PTA, school committee members.

Embedded Assessment:	Students can describe the steps they used in their design process and their evolving thoughts about the possible impacts of their design on other people.
Summative Assessment:	Focus on a local community or school project and have students identify its possible impact on various constituencies.
Theme:	Systems
Process:	Recognizing and Labeling Problems

By the end of 5th grade all students will know that --

Technology has been part of life on the earth since the advent of the human species. Like language, ritual, commerce, and the arts, technology is an intrinsic part of human culture, and it both shapes society and is shaped by it. The technology available to people greatly influences what their lives are like.

Suggested Activities:

Have students draw pictures showing different uses and types of technology from different time periods from prehistoric to modern times. Different groups can be assigned different periods. Have students interview a grandparent or other older person and discuss how household chores were different when they were young. Have students discuss the effect of the automobile or mass transit systems on how people live.

Embedded Assessment:	Students explain how technology influenced the lives of these people in various time periods.
Summative Assessment:	Students draw pictures or make models to speculate how technology will affect their future lives.
Theme:	Constancy and Change
Process:	Developing Generalizations

By the end of 5th grade all students will know that --

Any invention is likely to lead to other inventions. Once an invention exists, people are likely to think up ways of using it that were never imagined at first.

Suggested Activities:

Given pictures of a series of inventions, students arrange them in probable historical order and explain their choices. Give students a common object and have them suggest other uses for the object. Explore inventions which paved the way for video games.

Embedded Assessment:	A list of uses for an object which goes well beyond its present uses.
Summative Assessment:	Given a multi-purpose tool (i.e. a Swiss Army knife) have students list possible uses.
Theme:	Constancy and Change
Process:	Identifying Patterns and Relationships

The book Material World: A Global Family Portrait is a compendium of photographs of families from around the world. In each photograph, the family is standing outside of their home with all their possessions. The book is available through the public library system in Rhode Island. Use some of its pages to have students discuss the wide range of existing inventions, their possible uses, and the differences and similarities of artifacts across cultures.

By the end of 5th grade all students will know that --

Transportation, communications, nutrition, sanitation, health care, entertainment, and other technologies give large numbers of people today the goods and services that once were luxuries enjoyed only by the wealthy. These benefits are not equally available to everyone.

Suggested Activity:

Interview adults to find out what items in their homes were considered luxuries in the past. Interview recent immigrants to find out items which are available in average homes in their native countries. Ask what items are available in their native country, but not in the United States.

Embedded Assessment:	Make a chart to summarize results of the survey.
Summative Assessment:	Write a report about one item the student uses at home. The student should estimate and justify their view about how long ago this item was considered a luxury in the United States and speculate on where in the world it might still be a luxury.
Theme:	Constancy and Change
Process:	Interpreting and Evaluating Data, Interviewing

By the end of 5th grade all students will know that --

Scientific laws, engineering principles, properties of materials, and construction techniques must be taken into account in designing engineering solutions to problems. Other factors, such as cost, safety, appearance, environmental impact, and what will happen if the solution fails also must be considered.

Suggested Activity:

Tackle a real environmental problem in the school, such as capturing the water runoff from a leaky faucet or pipe in the building, a tree, or some other object in the school yard. Find a way to reuse the water.

Embedded Assessment:	Develop a concise statement of the problem and a proposed set of actions to address it.
Summative Assessment:	Identify some environmental impacts likely to be associated with a local community problem.
Theme:	Models
Process:	Building, Testing, Refining Prototypes

By the end of 5th grade all students will know that --

Because of their ability to invent tools and processes, people have an enormous effect on the lives of other living things.

Suggested Activity:

Create a photo collection of various tools and processes (e.g., clearcutting, dredging, landfills, construction and demolition) in use in your local area. For each visual, brainstorm possible effects on other living things.

Embedded Assessment:	Do one sample item in class before assigning the task.
Summative Assessment:	Pretend you are a tree. Describe the good and bad things people have done to you and your family.
Theme:	Systems
Process:	Communicating Information/Ideas

By the end of 8th grade all students will know that --

Technology cannot always provide successful solutions for problems or fulfill every human need.

Suggested Activities:

Students will view video footage concerning heart replacement with pumps and interview local medical personnel about the limitations of such technologies. Visit a hospital or nursing home to view how technology is used to fight disease and the effects of aging.

Embedded Assessment:	Class discussion will highlight the problems and continuing challenges with current heart pump technology.
Summative Assessment:	Students will define a scenario that describes a genuine breakthrough within a specific arena of technology.
Theme:	Constancy and Change
Process:	Proficiency in Reaching Decisions

By the end of 8th grade all students will know that --

Throughout history, people have carried out impressive technological feats, some of which would be hard to duplicate today even with modern tools. The purposes served by these achievements have sometimes been practical, sometimes ceremonial.

Suggested Activity:

Have student teams design and complete plans to build a scale model pyramid using rolled newspapers and masking tape similar to the ancient pyramids of Egypt or Meso- America.

Embedded Assessment:	Discuss the problems the ancient Egyptians, Mayans or Aztecs encountered and compare their solutions to yours.
Summative Assessment:	Identify another impressive feat from prior centuries and describe its purpose(s) and what would be needed today to accomplish the same feat, e.g., medieval cathedrals, seaworthy vessels, distance communications devices.
Theme:	Constancy and Change
Process:	Proficiency in Informed Action

Check out the series of books by David Macauley available in the public library, including Cathedral. Also look for Thor Heyerdahl, Kon-Tiki and The Ra Expedition.

By the end of 8th grade all students will know that --

Technology has strongly influenced the course of history and continues to do so. It is largely responsible for the great revolutions in agriculture, manufacturing, sanitation and medicine, warfare, transportation, information processing, and communications that have radically changed how people live.

Suggested Activity:

Create a visual history of the construction of Route 95 and its impact on Rhode Island's people, communities, environment and commerce.

Embedded Assessment:	Describe the benefits and problems that Route 95 has created for the citizens of Rhode Island.
Summative Assessment:	Describe in an essay how life would be different in the 1990's in RI without Route 95.
Theme:	Systems
Process:	Proficiency in Informed Action

THE NATURE OF TECHNOLOGY - Issues in Technology
Grade 9-12 (Benchmark 1 of 5)

By the end of 12th grade all students will know that --

Social and economic forces strongly influence which technologies will be developed and used. Which will prevail is affected by many factors, such as personal values, consumer acceptance, patent laws, the availability of risk capital, the federal budget, local and national regulations, media attention, economic competition, and tax incentives.

Suggested Activity:

Have students research a product that is available in other countries but not in the U.S. Students will give a short presentation relating to how social, economic and/or political conditions affect the product's availability in the U.S.

Embedded Assessment:	An outline of their research before going to an oral/written presentation.
Summative Assessment:	Producing a paper, video, advertisement, or presentation about the product, why it is not available in the USA, and taking a position for or against its introduction.
Theme:	Constancy and Change
Process:	Proficiency in Reaching Decisions About Issues

Have a UN Day. Students will represent different countries with different assets. Let them barter and trade for what they need, and deal with environmental issues. Make them do some research on their country prior to this simulation. Michael Specht, a science teacher at Classical HS in Providence, has played the 'World Game' with his students and has offered to help others get started.

By the end of 12th grade all students will know that --

Technological knowledge is not always as freely shared as scientific knowledge unrelated to technology. Some scientists and engineers are comfortable working in situations in which some secrecy is required, but others prefer not to do so. It is generally regarded as a matter of individual choice and values, not one of professional ethics.

Suggested Activity:

Classroom visit by a police/FBI forensic specialist, and a discussion of how secrecy plays a role in his/her occupation. OR Classroom visit by a patent attorney who deals with secrecy issues in technology. OR Students may give an oral presentation on some technology which is presently proprietary; and thus, there may be limits to the information they can research (e.g., Polaroid's instant photography). A local company competing in a world market would be a useful resource.

Embedded Assessment:	The student will explain the concept of proprietary secrecy and what the full implications of it are.
Summative Assessment:	Students will be exposed to a new fictitious technology which is proprietary and asked from a variety of perspectives to address the question, "Is secrecy necessary?". Multiple sides of the issue will be discussed by the students.
Theme:	Systems
Process:	Proficiency in Informed Action

THE NATURE OF TECHNOLOGY - Issues in Technology
Grade 9-12 (Benchmark 3 of 5)

By the end of 12th grade all students will know that --

In deciding on proposals to introduce new technologies or to curtail existing ones, some key questions arise concerning alternatives, risks, costs, and benefits. What alternative ways are there to achieve the same ends, and how do the alternatives compare to the plan being put forward? Who benefits and who suffers? What are the financial and social costs, do they change over time, and who bears them? What are the risks associated with using (or not using) the new technology, how serious are they, and who is in jeopardy? What human, material, and energy resources will be needed to build, install, operate, maintain, and replace the new technology, and where will they come from? How will the new technology and its waste products be disposed of and at what costs?

Suggested Activity:

Classroom debate on the issue of some new technology (e.g., nuclear or hydroelectric power plant, waste treatment plant, etc.) entering the school's community. Who wins, who loses? As an alternative, find out how much paper the school uses and determine it's real cost and develop a range of well-reasoned options to reduce identified negative impacts of the existing system.

Embedded Assessment:	Students will present a plan for technology assessment for a given technology.
Summative Assessment:	A persuasive essay which takes a position on a current issue involving science and technology within society and uses facts, opinions of self and others, and identified assumptions to make its case.
Theme:	Systems
Process:	

By the end of 12th grade all students will know that --

The human species has a major impact on other species in many ways: reducing the amount of the earth's surface to those other species, interfering with their food sources, changing the temperature and available chemical composition of their habitats, introducing foreign species into their ecosystems, and altering organisms directly through selective breeding and genetic engineering.

Suggested Activity:

Relate to students the story of the Suiki Crab during the 17th century. The Japanese emperor and his loyal troops were fleeing from enemy troops by sea, when a storm sank his ship. Soon after the sinking, Japanese fishermen caught crabs that appeared to have a human face on their back. The fishermen felt that the crabs with the human-like faces contained the souls of the Emperor's loyal troops. Therefore, the fishermen returned these crabs to the bay, thus selectively breeding this population of crabs with the face mutation.

Embedded Assessment:	Students will read the story and relate it to other local examples of humans' role in changing the ecosystem.
Summative Assessment:	Students should be able to apply this story to other situations such as changes in the oyster population in Narragansett Bay, changes in moth populations due to air pollution (e.g., peppered moth, *Biston betularia*) fish populations changing, and extinction of plants and animals.
Process:	Proficiency in Reaching Decisions
Theme:	Constancy and Change

A/V materials or readings on genetic engineering is also suggested, in preparation for a classroom visit by an horticulturist, animal breeder, or microbiologist who utilizes selective breeding in their occupation. SAVE THE BAY (272-3540) and other environmental organizations can be very helpful with resources in this area.

By the end of 12th grade all students will know that --

Human inventiveness has brought new risks as well as improvements to human existence.

Suggested Activities:

Field trip to hospital to explore how risks associated with handling patients have fostered new improvements in hospital procedures (e.g., radiation, hematology, child birth, outpatient ambulatory care). Explore EMF, low level radioactive waste, airline safety. Visit an EPA lab while studying the effects of toxins on living organisms.

Embedded Assessment:	Identify the areas of risk in the hospital environment that have spurred development of new technologies and new risks that have emerged.
Summative Assessment:	Perform a simple risk benefit analysis for a selected technology.
Process:	Problem Solving Proficiency
Theme:	Constancy and Change

Call the EPA Environmental Research Lab in Narragansett at 782-3000 for help in this area.